

**WHAT IS CLAIMED IS:**

1. A multi-component composite membrane comprising active layers and support layers, wherein a support layer is located between active layers.
- 5 2. The multi-component composite membrane according to claim 1, wherein a component of a support layer is at least one polymer selected from the group consisting of high density polyethylene, low density polyethylene, linear low density polyethylene, polypropylene, high crystalline polypropylene, polyethylene-propylene copolymer, polyethylene-butylene copolymer, polyethylene-hexene copolymer, polyethylene-octene copolymer, polystyrene-butylene-styrene copolymer, polystyrene-ethylene-butylene-styrene copolymer, polystyrene, polyphenylene oxide, polysulfone, polycarbonate, polyester, polyamide, polyurethane, polyacrylate, polyvinylidene chloride, polyvinylidene fluoride, polysiloxane, polyolefin, ionomer, polymethylpentene, and hydrogenated oligocyclopentadiene (HOCP), and a derivative thereof.
- 15 3. The multi-component composite membrane according to claim 2, wherein the high crystalline polypropylene has one or more physical properties selected from the group consisting of a density of 0.905 g/cc or more, a melting point of 164°C or higher, a crystallization temperature of 125°C or higher, a crystallinity of 50% or greater, an isotacticity of 96% or greater, and an atactic fraction of 5% or less.
- 20 4. The multi-component composite membrane according to claim 1, wherein a pore size of a support layer ranges from 0.001 to 10  $\mu\text{m}$ .
5. The multi-component composite membrane according to claim 1, wherein a thickness of a support layer ranges from 1 to 50  $\mu\text{m}$ .
- 25 6. The multi-component composite membrane according to claim 1, wherein a component of the active layers is one or more polymers selected from the group consisting of polyethylene, polypropylene, polyvinylidene fluoride, polyvinylidene fluoride-hexafluoropropylene copolymer, polyethylene oxide, polypropylene oxide, polybutylene oxide, polyurethane, polyacrylonitrile, polyacrylate, polyacrylic acid, polyamide, polyacrylamide, polyvinylacetate,
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polyvinylpyrrolidone, polytetraethylene glycol diacrylate, polysulfone, polyphenylene oxide, polycarbonate, polyester, polyvinylidene chloride, polysiloxane, and polyolefin ionomer, and a derivative thereof.

7. The multi-component composite membrane according to claim 5 6, wherein a solvent for the component of the active layers is one or more solvents selected from the group consisting of 1-methyl-2-pyrrolidone (NMP), acetone, ethanol, n-propanol, n-butanol, n-hexane, cyclohexanol, acetic acid, ethyl acetate, diethyl ether, dimethyl formamide (DMF), dimethylacetamide (DMAc), dioxane, tetrahydrofuran (THF), dimethyl sulfoxide (DMSO), 10 cyclohexane, benzene, toluene, xylene, and water, and a mixture thereof.

8. The multi-component composite membrane according to claim 1, wherein a pore size of an active layer is equal to or less than 10  $\mu\text{m}$ .

9. The multi-component composite membrane according to claim 1, wherein a thickness of an active layer ranges from 0.01 to 20  $\mu\text{m}$ .

10. The multi-component composite membrane according to claim 1, wherein air permeability of the composite membrane is equal to or less than 7,000 sec/100 cc.

11. The multi-component composite membrane according to claim 1, wherein a wet-out rate of the composite membrane is equal to or less than 20 30 seconds.

12. The multi-component composite membrane according to claim 1, wherein the composite membrane comprises two or more active layers and one or more support layers, and the composite membrane has a structure of triple or multiple layers.

13. The multi-component composite membrane according to claim 1, wherein a support layer is blended or laminated with the polymer component of claim 2.

14. The multi-component composite membrane according to claim 1, wherein the composite membrane is used for water treatment, hemodialysis, 30 enzyme purification, patches for drug delivery, gas separation, pervaporation, reverse osmosis, or electrolysis separation.

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15. A separator for batteries comprising the multi-component composite membrane of claim 1.

16. A rechargeable lithium ion battery or a rechargeable lithium ion polymer battery comprising the multi-component composite membrane of claim 1 as a separator.

17. A preparation method of a multi-component composite membrane comprising steps of:

- a) preparing a precursor film by injection of a polymer, which is used, for a support layer into an extruder;
- 10 b) annealing the precursor film at a temperature less than a melting point of the polymer;
- c) irradiating ion beams on either or both surfaces of the annealed precursor film;
- d) coating both surfaces of the irradiated precursor film with a polymer solution, which is used for an active layer, with the help of an reactive gas;
- 15 e) drying the coated precursor film;
- f) low temperature-stretching the dried precursor film at a temperature less than room temperature;
- 20 g) high temperature-stretching the low temperature-stretched precursor film at a temperature less than a melting point of the polymer; and
- h) heat-setting the high temperature-stretched precursor film under tension at a temperature less than the melting point of the polymer.

18. The preparation method according to claim 17, wherein the polymer solution of step d) is coated on both sides of the precursor film by dip-coating.

19. The preparation method according to claim 17, wherein a concentration of the polymer solution of step d) is equal to or greater than 0.01 wt%.

20. The preparation method according to claim 17, wherein the drying of step e) is performed at a relative humidity ranging from 1 to 100%.

21. The preparation method according to claim 17, wherein the drying of step e) is performed under saturated vapor pressure.

5 22. The preparation method according to claim 17, wherein the drying of step e) is performed under a gas atmosphere selected from the group consisting of nitrogen, oxygen, carbon dioxide, and air atmosphere.

23. The preparation method according to claim 17, wherein an active layer having a thickness in the range of 0.1 to 20  $\mu\text{m}$  is formed through  
10 the coating and drying of steps d) and e).

24. The preparation method according to claim 17, wherein the irradiating of ion beams of step c) is performed under a vacuum ranging from  $10^{-1}$  to  $10^{-6}$  torr.

25. The preparation method according to claim 17, wherein the  
15 irradiating of ion beams of step c) is performed by activation of electrons and a gas selected from the group consisting of hydrogen, helium, oxygen, nitrogen, carbon dioxide, air, fluorine, neon, argon, krypton,  $\text{N}_2\text{O}$ , and a mixture thereof such that the gas has an energy ranging from 0.01 to  $10^6$  keV; and irradiation of the ion beams on the surface of the precursor film.

20 26. The preparation method according to claim 17, wherein an irradiation amount of the ion beams ranges from  $10^5$  to  $10^{20}$  ions/ $\text{cm}^2$ .

27. The preparation method according to claim 17, wherein an irradiation of step c) is performed under a gas atmosphere selected from the group consisting of helium, hydrogen, nitrogen, ammonia, carbon monoxide,  
25 carbon dioxide, chlorofluoro methane, methane, and  $\text{N}_2\text{O}$  atmospheres; and a mixture thereof.

28. The preparation method according to claim 27, wherein the flow rate of the reactive gas ranges from 0.5 to 20  $\text{mL/minute}$ .

29. The preparation method according to claim 17, wherein the  
30 preparation steps of the multi-component composite membrane can be performed in any combination regardless of the sequence.